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(54) **Floor covering.**

(57) A multi-coloured floor covering is disclosed comprising a matrix (44) of thermoplastic material and a plurality of visually distinct chips (46) of thermoplastic material embedded in the matrix (44). Particulate alumina (50) is dispersed throughout both the matrix (44) and the chips (46). A floor covering with long-life slip resistance is achieved in a simple and reliable manner.

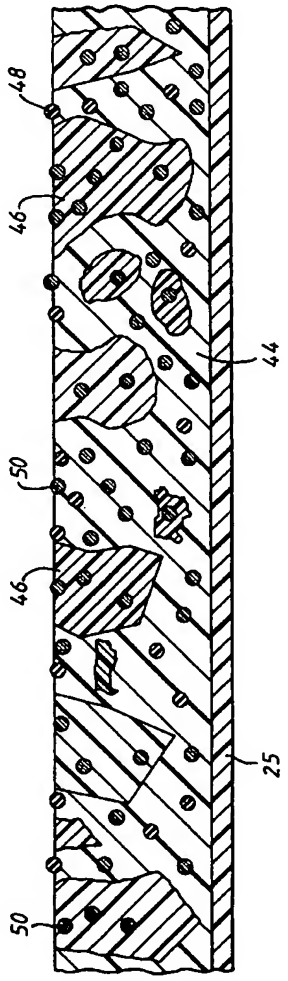


Fig. 2

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## Field of the invention

This invention relates to a floor covering, in particular to a safety floor covering having improved slip resistance characteristics, and more particularly to a multi-colour safety floor covering.

## Background to the invention

Floor coverings are known comprising a matrix of thermoplastic material and a plurality of visually distinct chips of thermoplastic material embedded therein. By the term "chips" as used herein, we mean to include both regularly and irregularly shaped pieces, including flakes, strips, spheres, shreds, splinters, granules, granulates and the like. One or a mixture of pigments is included in the thermoplastic chips and/or in the matrix material, thereby to produce a multi-colour effect.

Safety floor coverings are known in which particulate abrasive material is dispersed in a matrix of thermoplastic material. Thus, British patent specification GB 1 231 005 (Welwyn Plastics (1955) Limited) describes a floor covering containing grits of abrasive material such as alumina having a size of 0.075 mm to 1.0 mm, the floor covering being formed by mixing the abrasive material with PVC paste, coating the mixture on a sheet of base material and curing the coated sheet. After curing, the material can be embossed with a textured roller to permit the grits to penetrate through the top skin. Once this has occurred, the very hard alumina is sufficiently exposed to give a flooring with improved non-slip properties and improved hard wearing properties.

A disadvantage of locating the abrasive grits only at the surface of the thermoplastic matrix is that as the floor covering becomes worn, by loss of the upper surface, a fresh surface is exposed with fewer exposed abrasive grits leading to a loss of the non-slip properties.

In British patent specification GB 2 152 843-B (Welwyn Plastics (1955) Limited) there is described a floor covering which, in addition to abrasive grits, comprises coloured quartz particles to provide a multi-coloured effect. Particles of silicon carbide are applied to the upper surface of the thermoplastic matrix before it is cured, which provides a high percentage of abrasive material at the tread surface while it is brittle and breaks through the skin of the thermoplastic material. There results a coating to the base material which maintains its slip resistant properties throughout the working life of the floor covering.

## Summary of the invention

We have now discovered that a multi-coloured floor covering with long-life slip resistance can be achieved in a simple and reliable manner.

Thus, according to a first aspect of the invention there is provided a floor covering comprising a matrix of thermoplastic material and a plurality of visually distinct chips of thermoplastic material embedded in the matrix, characterised by particulate alumina being dispersed throughout both the matrix and the chips.

By the term "thermoplastic material" we mean any plastic material which is cured to a form-retaining state by heating and subsequent cooling. Preferably this material is polyvinylchloride, a polyolefin resin, mixtures thereof and mixtures of other synthetic resins and mixtures including natural materials such as natural rubber. The thermoplastic material preferably has a softening temperature between 150°C and 210°C. Preferably, the thermoplastic material used for the matrix is the same as that used for the chips, which has an advantage of providing a more homogeneous mix. Suitable plasticisers include phthalates, adipates and phosphates.

Usually, the matrix is coated on a base material in sheet form which provides the floorings with strength and dimensional stability. For the base, various flexible porous sheet materials such as hessian, woven cotton fabric felt, paper, metal foil, woven fibre glass or synthetic mesh material may be used. We prefer to use non-woven polyester sheet, reinforced with glass fibres to increase tear resistance. A suitable thickness for the base material is from 0.1 to 1.0 mm, with a sheet weight of from 20 to 200 g/m$^2$. The base material may include a foam material where the intended application of the product so demands. Generally, the matrix is coated on one side only of the base material, but it is also possible for the base material to be embedded in the matrix material.

A suitable thickness for the overall product, whether a base material be present or not, is from 1.0 to 5.0 mm, preferably from 2.0 mm to 4.5 mm.

In order to ensure a visual distinction between the matrix and the chips, pigments may be included in one or both. According to the desired colour, an appropriate mixture of pigments may be employed. We prefer to employ a matrix of one colour and a mixture of chips of various other colours, thereby to achieve a multi-colour effect. It is also possible not to include a pigment in the matrix, so long as at least one pigment is included in the chips, thereby to provide the matrix with a substantially transparent appearance.

The pigments may be organic or inorganic, but are preferably heat and light stable and compatible with

each other and with the thermoplastic material of the matrix and the chips. The level of pigment used may be up to 1% by weight of the associated thermoplastic material. In addition to the chips, other particulate material may be dispersed throughout the matrix. Thus, coloured quartz may be included to add to the multi-colour effect and silicon carbide may be included which, in view of its highly reflective nature, confers an attractive finish to the surface of the floor covering.

The alumina used in the floor covering of the invention is preferably alpha-$Al_2O_3$, which occurs in nature as corundum. While in its pure form alumina is colourless, the presence of various coloured impurities when derived from natural sources is not a disadvantage. Ideally, the alumina has an average particle size lying within the range of from 0.1 mm to 2.0 mm, most preferably from 0.4 to 0.7 mm, such as about 0.6 mm.

While not wishing to be bound by theory, it appears that it is the combination of relatively low cost, hardness, brittleness, crystalline form and compatibility which provides alumina with a unique benefit in the floor coverings according to the invention.

The amount of alumina present in the matrix and the chips is preferably such that the ratio of the thermoplastic material to the alumina is from 100:1 to 1:1 by weight, preferably from 6:1 to 3:1 by weight, and we have found it suitable to use the same level of alumina in the matrix as in the chips.

The level of visually distinct chips in the floor covering according to the invention and their size depends in part on the desired multi-coloured design, but we have found that a ratio of matrix to chips of from 1.5:1 to 20:1 by weight, and an average chip size of from 1.0 mm to 10.0 mm is suitable. The chips will usually be of irregular shape.

According to a second aspect of the invention there is provided a method for forming the floor covering, comprising the sequential steps of:

(i) forming a layer of thermoplastic paste;

(ii) scattering visually distinct chips of thermoplastic material on the thermoplastic paste layer; and

(iii) curing the thermoplastic paste layer;

characterised in that the thermoplastic paste and the visually distinct chips both have particulate alumina dispersed therein.

In one embodiment of the invention, the chips are made as follows. In a first mixing step, a thermoplastic paste can be prepared containing a thermoplastic material, plasticisers, pigment and other optional ingredients. It is an advantage to mix the alumina in with this paste in a separate step. Alumina, being abrasive, may tend to cause excessive wear in the first mixer which has to be operated under such conditions that a very homogeneous mixture of ingredients is formed, whereas the alumina need only be stirred into the paste with sufficient thoroughness to avoid settling.

The paste mixture may be formed into the necessary layer for curing by coating on a suitable backing, which may or may not be identical to that used subsequently for supporting the matrix of the floor covering. Alternatively, the layer may be formed by extrusion or by calendering.

The layer of thermoplastic paste containing the alumina is then cured, for example by passing through an oven at a temperature of from 150°C to 200°C. A heating time of up to 5 minutes, say 2 to 3 minutes is suitable. The cured sheet is now passed to a granulator in which the chips of desired size and shape are formed. The chips are stored for later use.

By repeating the process a number of times, varying the nature and level of the pigment and the mesh size of the granulator screen plate, chips of various appearance can be produced. These may be separately stored or immediately mixed together to form a composite blend.

As an alternative method of forming the chips, the thermoplastic paste containing the alumina may be applied in discrete surface areas onto a supporting surface by means of a rotary screen printing cylinder, the applied paste being cured by passing the supporting surface adjacent a heat source and the chips so formed being removed from the supporting surface.

In the next repeat of the process the alumina-containing thermoplastic paste is used for forming the matrix of the floor covering. Again, it may be coated on an appropriate backing. Before being passed to the curing oven, the desired composite blend of chips is scattered onto the uppers surface of the paste. After leaving the oven, we prefer that the product, before cooling, passes between a pair of pressure rollers which press the chips into the matrix leaving the product with a substantially flat tread surface. After cooling, the product may be stored as desired, for example in the form of rolls or tiles.

In a preferred embodiment of the invention, the matrix is built up by successive coatings, each coating being cured and the product cooled before the next coating is applied. Ideally, the chips are added to each coating, but it is not essential that chips of the same shape, size and colour are added to each coating. Various design effects can be achieved by applying different chips to different coatings.

Preferred embodiments of the invention

The invention will now be further described, purely by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic representation of an apparatus useful for forming floor coverings according to the invention; and

Figure 2 is a cross-section, not to scale, of a product according to the invention.

In the apparatus shown schematically in Figure 1, PVC powder (labelled PVC), a pigment and a plasticiser (labelled ADD) are mixed thoroughly in a mixer 10 and the plastisol or paste so formed is passed to a second mixer 12 where fine particle size alumina (labelled $Al_2O_3$) is dispersed therein. A suitable composition for the paste leaving the mixer 12 would be (by weight):

| | |
|---|---|
| PVC | 39% |
| Pigment (s) | 6% |
| Phthalate plasticiser | 30% |
| Epoxidised soyabean oil (viscosity modifier) | 7% |
| Calcium-zinc stabilisers | 3% |
| Alumina | 15% |

The alumina-containing paste then follows one of two selectable routes. According to a first route the paste is coated onto a web of base material 13 supplied from a source 14 by way of a coating roller 16 and doctor blade 18. The coated base material passes through an oven 20 which is at a temperature of 175°C for 2.5 minutes to cure the PVC and after cooling the coloured alumina-containing sheet product is passed to a granulator 22 where it is broken up into chips having an average size of 5 mm. The chips are then passed to one of a number of storage locations 24a, b, c etc according to chip size and shape and pigment colour. By changing the pigment in the ingredients fed to the mixer 10, or by omitting the pigment, and by changing the settings of the granulator 22, a series of chips of different colours, shapes and sizes can be produced and stored at 24.

The ingredients fed to the mixer 10 are changed again, by changing the pigment or by omitting the pigment, but now the output of the mixer 12 is fed to the input of the main coating line where the PVC paste is coated on a web of base material 25 supplied from a source 26 by way of a coating roller 28 and doctor blade 30. In the main coating line a scatter applicator 32 is positioned between the coating roller 28 and an oven 34. The scatter applicator 32 is fed via a mixer 36 with chips from one or more of the storage locations 24a, b, c etc. selected according to the desired visual effect. These chips are scattered over the surface of the un-cured PVC on the base material and become embedded therein. The coated base material now passes through oven 34 at a temperature of 175°C for 2.5 minutes where the PVC of the matrix is cured. Before cooling, the product passes between a pair of rollers 37, 38 where the chips are pressed into the interior of the PVC and a generally flat upper surface is achieved. A number of embossing rollers not shown may follow before the product is cooled at 40 and wound into a roll 42 for storage.

The product produced by the method set out above has the appearance in cross-section shown diagrammatically in Figure 2.

Figure 2 shows the base material 25 supporting a matrix 44 of cured PVC in which are embedded a number of chips 46 also of cured PVC. The matrix 44 and/or the chips 46 are pigmented or otherwise adapted to be visually distinct from each other. Dispersed throughout both the matrix and the chips are particles 50 of alumina. Other discrete particles 48 may also be present near the surface or dispersed throughout the matrix 44 formed of other materials such as silicon carbide or coloured quartz.

As the product becomes worn in use, some of the upper surface is lost, progressively exposing more originally interior material. As a result of the particulate alumina being dispersed throughout both the matrix 44 and the chips 46, some particulate alumina is always present at the surface. This particulate alumina, being brittle, is broken up as the floor covering is walked on and, being hard, digs into the thermoplastic material, whether of the matrix or of any surface exposed chips, causing microscopic indentations in the upper surface. It is this effect which is thought to be responsible for the slip resistance properties of the product.

The presence of the particulate alumina in both the matrix and the chips means that this slip resistance benefit is achieved no matter what the ratio of chips to matrix may be, thereby giving the designer greater freedom in his choice of multi-colour patterns and ensuring that the slip resistance is maintained in wet conditions

and throughout the wear life of the flooring.

For the measurement of slip resistance, British Standard 812, Part 114:1989 may be applied using a friction tester according to the Transport and Road Research Laboratory design.

## Claims

1. A floor covering comprising a matrix (44) of thermoplastic material and a plurality of visually distinct chips (46) of thermoplastic material embedded in the matrix (44), characterised by particulate alumina (50) being dispersed throughout both the matrix (44) and the chips (46).

2. A floor covering according to claim 1, wherein the matrix material (44) comprises PVC.

3. A floor covering according to any preceding claim, wherein a pigment is included in the matrix material (44).

4. A floor covering according to any preceding claim, wherein a pigment is included in the thermoplastic chips (46).

5. A floor covering according to any preceding claim, further comprising a base material (25).

6. A floor covering according to any preceding claim further comprising additional particulate material (48) dispersed throughout the matrix (44).

7. A floor covering according to any preceding claim, wherein the weight ratio of the matrix (44) to the visually distinct chips (46) is from 1.5:1 to 20:1.

8. A floor covering according to any preceding claim, wherein the level of alumina in the matrix (44) is such that the ratio of the thermoplastic material of the matrix (44) to the alumina is from 100:1 to 1:1 by weight.

9. A floor covering according to any preceding claim wherein the level of alumina in the chips (46) is such that the ratio of the thermoplastic material of the chips (46) to the alumina is from 100:1 to 1:1 by weight.

10. A floor covering according to any preceding claim, wherein the chips (46) have an average dimension of from 1.0 mm to 10.0 mm.

11. A floor covering according to any preceding claim, wherein the alumina (50) has a particulate size of from 0.2 mm to 2 mm.

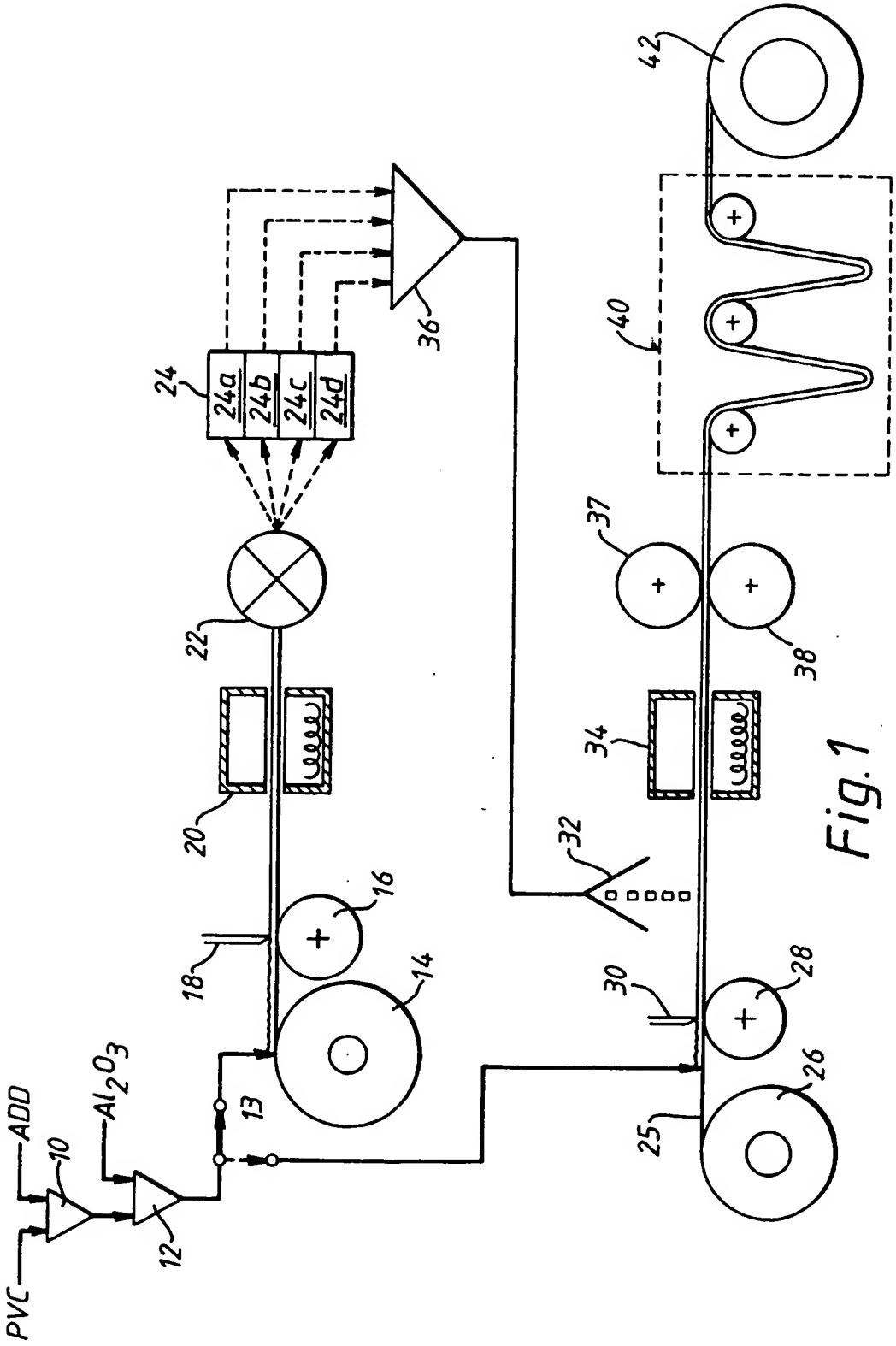
12. A method for forming a floor covering according to Claim 1, comprising the sequential steps of:
    (i) forming a layer of thermoplastic paste;
    (ii) scattering visually distinct chips of thermoplastic material on the thermoplastic paste layer; and
    (iii) curing the thermoplastic paste layer;
    characterised in that the thermoplastic paste and the visually distinct chips both have particulate alumina dispersed therein.

13. A process according Claim 12, wherein the thermoplastic paste is formed by mixing a thermoplastic material and a plasticiser in a first mixer and passing the output thereof to a second mixer in which the particulate alumina is added.

14. A method according to Claim 12 or 13, wherein the visually distinct chips are formed by a process comprising the sequential steps of forming a layer of thermoplastic paste and having particulate alumina dispersed therein, curing the thermoplastic paste and granulating the product so formed.

15. A method according to Claim 14, wherein the process for forming the visually distinct chips is repeated a plurality of times under different conditions and the products thereof are mixed with each other to give a blend of chips of differing appearance.

16. A process according to any one of Claims 12 to 15, wherein after curing the thermoplastic paste layer, the visually distinct chips are pressed into the thermoplastic paste layer.


PVC
ADD
10
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$Al_2O_3$
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24a
24b
24c
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Fig. 1

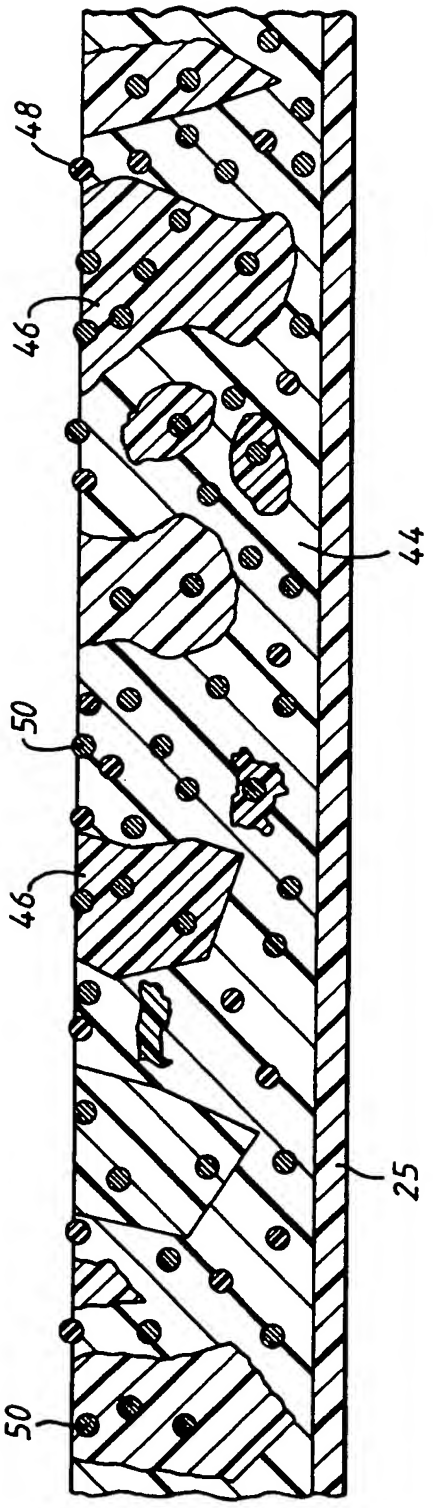


Fig. 2

European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 93 30 6260

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.5) |
|---|---|---|---|
| D,A | GB-A-1 231 005 (WELWYN PLASTICS (1955) LTD.)<br>* the whole document *<br>--- | 1-3,5,6,8,11-13 | D06N7/00 |
| D,A | GB-A-2 152 843 (WELWYN PLASTICS (1955) LTD.)<br>* the whole document *<br>--- | 1-3,5,6,8,11-13 | |
| A | US-A-3 400 005 (R. P. DESCH ET AL.)<br>* the whole document *<br>--- | 1-7,10,12-16 | |
| A | WO-A-87 01972 (TARKETT INC.)<br>* page 6, line 7 - page 7, line 10; claim 1 *<br>* page 12, line 1 - page 15, line 6 *<br>----- | 1-7,10,12,15,16 | |
| | | | TECHNICAL FIELDS SEARCHED (Int.Cl.5) |
| | | | D06N |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 15 November 1993 | PAMIES OLLE, S |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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